CLAIMS

1. A method for detecting degeneration in mammalian cartilage comprising:

applying a current to said cartilage between at least two surface points of said cartilage;

measuring an amplitude of a voltage difference between said at least two surface points resulting from said application of current to said cartilage;

dividing said measured amplitude of said voltage difference by an amplitude of said current to determine an impedance of said cartilage, and

comparing said impedance to a normal impedance value of said cartilage previously determined from clinically normal cartilage to detect degeneration of said cartilage.

2. The method for detecting degeneration in mammalian cartilage, as per claim 1, wherein said current is applied into said cartilage at varying depths by changing a spatial distance between said at least two surface points to vary a spatial wavelength of said current.

3. The method for detecting degeneration in mammalian cartilage, as per claim 2, wherein said current is applied to said cartilage via electrodes of an interdigitated electrode array and said spatial distance between said at least two surface points is varied by selectably addressing different electrodes of said interdigitated electrode array to apply said current.

4. The method for detecting degeneration in mammalian cartilage, as per claim 2, wherein

said current is applied into said cartilage a short distance from a surface of said cartilage compared to an overall depth of said cartilage to determine an impedance of a superficial region of said cartilage.

5. The method for detecting degeneration in mammalian cartilage, as per claim 2, wherein said current is applied into said cartilage substantially the full depth of said cartilage to determine an average impedance of said cartilage.

6. The method for detecting degeneration in mammalian cartilage, as per claim 1, wherein said measuring step is performed simultaneously with a current generated stress measurement.

7. The method for detecting degeneration in mammalian cartilage, as per claim 6, wherein said current is applied at a frequency in the range of 0.025-1 Hz.

8. The method for detecting degeneration in mammalian cartilage, as per claim 7 wherein said current is sequentially applied at a plurality of frequencies in the range of 0.025-1 Hz and said measuring step is performed at each of said plurality of frequencies.

9. The method for detecting degeneration in mammalian cartilage, as per claim 1, wherein said current is applied at a frequency of about 1 KHz.

10. A system for detecting degeneration in mammalian cartilage by determining an impedance of said cartilage, said system comprising:

a self contained surface probe having a set of excitation electrodes for applying a current to said cartilage between at least two surface points of said cartilage;

a current source operatively connected to said electrodes and providing said current to said electrodes, and

a computing device operatively connected to said electrodes for measuring an amplitude of a voltage difference between said excitation electrodes resulting from said application of said current and normalizing said amplitude to said current to determine said impedance of said cartilage.

11. The system for detecting degeneration in mammalian cartilage, as per claim 10, wherein said set of excitation electrodes comprises a plurality of selectably addressable interdigitated electrodes.

12. The system for detecting degeneration in mammalian cartilage, as per claim 10, wherein said excitation electrodes comprise a metal salt.

13. The system for detecting degeneration in mammalian cartilage, as per claim 12 wherein said excitation electrodes comprise silver chloride.

14. The system for detecting degeneration in mammalian cartilage, as per claim 10, said self contained surface probe further having a stress sensor for detecting a current generated stress induced in said cartilage by said applied current and transducing said current generated stress into one of a voltage or current, said stress sensor comprising a set of electrodes for transmitting said voltage or current to said computing device, said computing device performing processing on said received voltage or current to determine an electrokinetic parameter of said cartilage.

15. The system for detecting degeneration in mammalian cartilage, as per claim 10, said system further comprising:

a waveform generator, said waveform generator operatively connected to said current source and providing said current source with a time varying voltage waveform, said time varying voltage waveform causing said current source to generate a time varying current for application to said cartilage via said excitation electrodes.

16. The system for detecting degeneration in mammalian cartilage, as per claim 15, wherein said current source comprises:

a bi-directional op-amp, said op-amp having an inverting input connected to ground and an output connected to a first excitation electrode of said set of excitation electrodes;

a first resistor having a first terminal operatively connected to an output of said waveform generator and a second terminal connected to a non-inverting input of said op-amp;

a variable resistor having a first terminal connected to said non-inverting input of said op-amp and a second terminal connected to a first circuit node;

a second resistor having a first terminal connected to said first circuit node and a second terminal connected to ground, and

a third resistor having a first terminal connected to said first circuit node and a second terminal connected to a second excitation electrode of said set of excitation electrodes.

17. An arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, said probe comprising:

an inner core, said inner core having a first surface, a second surface substantially parallel to said first surface and at least one side surface connecting said first and second surface;

said first surface having a set of electrodes mounted thereon, said electrodes having at least two electrical conductors extending from said set of electrodes along said at least one side surface;

said at least one side surface having at least two electrically conductive plates thereon, said electrically conductive plates for respectively contacting said at least two conductors extending along said side surface, each of said at least two electrically conductive plates having electrical conductors connected thereto for providing said current to said electrodes, said electrical conductors connected to said at least two electrically conductive plates extending through a substantially hollow portion of said inner core;

said second surface having a recessed portion, said recessed portion connecting to said substantially hollow portion of said inner core;

a hollow pusher/plunger having one end thereof engaging said recess formed on said second surface, said electrical conductors connected to said conductive plates extending from said recessed portion into said hollow pusher/plunger and extending inside said hollow

pusher/plunger;

a first sheath covering at least a portion of said inner core, said first sheath having an opening at an end co-located to said first surface for exposing said set of electrodes, and

a second sheath covering said first sheath, said inner core and at least covering a portion of said hollow pusher/plunger, said second sheath having an opening at an end co-located to said first surface for exposing said set of electrodes.

18. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 17, wherein

a first portion of said inner core, said hollow pusher/plunger and said second sheath comprise a conductive material, and

a second portion of said inner core and said first sheath comprise a non-conductive material.

19. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 17, wherein said first sheath provides pressure to said at least two electrical conductors extending from said set of electrodes such that said at least two electrical conductors contacts said electrically conductive plates.

20. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 17, wherein said set of electrodes comprises at least four interdigitated electrodes, said at least two electrical conductors extending from said electrodes comprises at least four electrical conductors and said at least two electrically conductive plates comprises at least four electrically conductive plates.

21. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 17, wherein said first surface comprises a shaped recess formed thereon and said set of electrodes comprises a correspondingly shaped backing plate formed thereon, said shaped recess and said shaped backing plate providing a proper orientation such that said electrical conductors extending from said set of electrodes are aligned with said electrically conductive plates when said set of electrodes is mounted on said first surface.

22. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 17, wherein said set of electrodes is a combined electrode and transducer structure.

23. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 22, wherein said combined electrode and transducer structure

comprises:

interdigitated excitation electrodes formed of a conductive material for application of said current to said mammalian cartilage;

an insulating sheet having said excitation electrodes bonded to the lower insulating surface thereof and having its upper surface metalized for electrical grounding, and

a piezoelectric polymeric film for transducing mechanical stress to one of a current or a voltage having its upper and lower surfaces metalized, said lower metalized surface of said piezoelectric polymeric film bonded to said upper metalized surface of said insulating sheet, said upper metalized surface of said piezoelectric polymeric film formed into transducer electrodes for transmitting said current or voltage to a detector.

24. The arthroscopic probe for applying a current to mammalian cartilage in order to determine an impedance of said mammalian cartilage so as to detect degeneration of said cartilage, as per claim 22, wherein said probe is additionally utilized to make a current generated stress measurement of said mammalian cartilage.